

1-72/

An Announcement of Highway Safety Literature

... A Bi-Monthly Abstract Journal

HSL No. 72-9 May 12, 1972 HS-010 880 - HS-010 953, HS-800 575, HS-810 193, HS-820 181, 200, 201 - 202



U.S. International Transportation Exposition
Dulles International Airport
Washington, D.C.
May 27-June 4, 1972

HSL No. 72-9
May 12, 1972



THIS ISSUE CONTAINS:

HS-010 880 - HS-010 953
HS-800 575
HS-810 193
HS-820 181, 200, 201 - 202

U.S. Department of Transportation / National Highway Traffic Safety Administration

Handwritten scribbles at the bottom left of the page.

An Announcement of
HIGHWAY SAFETY LITERATURE
... A Bi-Monthly Abstract Journal

Published twice-a-month by the National Highway Traffic Safety Administration,
Research Institute, Office of Accident Investigation and Data Analysis
Washington, D.C. 20590

INTRODUCTION

Publications such as journal articles, proceedings, and research reports announced in *Highway Safety Literature* include some of the most recent additions to the collection of the NHTSA Scientific & Technical Information Service. Subject areas covered include all phases of highway, motor vehicle, and traffic safety, especially those encompassed by the National Traffic and Motor Vehicle Safety Act of 1966 and the Highway Safety Act of 1966.

Individual issues of *HSL* are numbered according to the year and the issue number within that year; thus, 72 designates the year and 1, 2, 3, etc. the individual issues. To aid the user in locating citations by the HS-number, the cover bears the inclusive entry number for each issue.

Entries in *HSL* are arranged according to the NHTSA Subject Category List shown in the Table of Contents. The list is a two-level arrangement consisting of five major subject fields subdivided into 59 subject groups. Documents related directly to

the National Highway Traffic Safety Administration (NHTSA) are announced in a separate section headed NHTSA DOCUMENTS and are numbered in five distinct series: NHTSA Accident Investigation Reports (HS-600 000 series), NHTSA Compliance Test Reports (HS-610 000 series), NHTSA Contractors Reports (HS-800 000 series), NHTSA Staff Speeches, Papers, etc. (HS-810 000 series), and NHTSA Imprints (HS-820 000 series). For NHTSA DOCUMENTS in series HS-600 000 and HS-610 000, individual full case reports are available for inspection at the National Highway Traffic Safety Administration. HS-800 000 series and HS-820 000 series are available for purchase from NTIS or GPO (see page ii). Although announced together in a separate section, these documents are also assigned specific subject categories for machine retrieval.

A document which contains a number of separate articles is announced as a complete volume in the subject category most applicable to it as a whole. Entries for the individual articles appear in their most specific subject category.

SAMPLE ENTRIES

Subject Category Array

NHSB Accession no HS-800 218 Fld. 5/21; 5/9

Title of document AN INVESTIGATION OF USED CAR SAFETY STANDARDS--SAFETY INDEX: FINAL REPORT. VOL. 6 - APPENDICES G-L

Personal author(s) by E. N. Wells; J. P. Fitzmaurice; C. E. Guilliams; S. R. Kalin; P. D. Williams

Corporate author Operations Research, Inc.

Collation

Publication date 1969 150p
Contract FH-11-6921
Report no. ORI-TR-553-Vol-6; PB-190 523

Abstract Appendices G-L to this study of used car safety standards include: indenture model diagrams for classes I-IV motor trucks; degradation, wear, and failure data for motor truck classes I-IV; and safety index tables for classes I-IV motor trucks.

Search terms; Wear; Trucks;
Failures; Used cars; Inspection
standards

AVAILABILITY: NTIS

HS-004 497 Fld. 5/19

**AUTO THEFT--THE PROBLEM AND
THE CHALLENGE**

by Thomas A. Williams, Sr.

Journal citation Published in *FBI Law Enforcement Bulletin* v37 n12 p15-7 (Dec 1968)

Gives figures on the extent of the auto theft problem and comments on anti-theft devices available now or in the planning stage.

Search terms: Theft; Theft protection; Stolen cars

(Note: If the date of a report or Journal article is not given, the small letters nd will appear)

TABLE OF CONTENTS

NOTE: () Numbers in parentheses following certain subject groups indicate the Highway Safety Program Standards (No. 1, and up) and/or Federal Motor Vehicle Safety Standards (No. 101 and up) which may apply to these groups.

INTRODUCTION AND

SAMPLE ENTRIES	Inside Front Cover
AVAILABILITY OF DOCUMENTS	ii

NHTSA SUBJECT FIELDS AND GROUPS

1/0 ACCIDENTS	1
/1 Emergency Services (11, 15-16)	
/2 Injuries	
/3 Investigation (10, 14-15)	
/4 Locations (9, 14)	
/5 Statistical data	
2/0 HIGHWAY SAFETY	3
/1 Breakaway Structures	
/2 Communications	
/3 Debris Hazard Control and Cleanup (15-16)	
/4 Design and Construction (12, 14)	
/5 Lighting (14)	
/6 Maintenance (12)	
/7 Meteorological Conditions	
/8 Police Traffic Services (15)	
/9 Traffic Control (13-14)	
/10 Traffic Courts (7)	
/11 Traffic Records (10)	
3/0 HUMAN FACTORS	6
/1 Alcohol (8, 14)	
/2 Anthropomorphic Data	
/3 Cyclists	
/4 Driver Behavior	
/5 Driver Education (4, 14)	
/6 Driver Licensing (5, 10, 14)	
/7 Drugs Other Than Alcohol	
/8 Environmental Effects	
/9 Impaired Drivers	
/10 Passengers	
/11 Pedestrians (14-15)	
/12 Vision	

4/0 OTHER SAFETY-RELATED AREAS	10
/1 Codes and Laws (6)	
/2 Community Support (17)	
/3 Cost Effectiveness	
/4 Governmental Aspects	
/5 Information Technology	
/6 Insurance	
/7 Mathematical Sciences	
/8 Transportation Systems	

5/0 VEHICLE SAFETY	10
---------------------------------	-----------

* All Federal Motor Vehicle Safety Standards apply to passenger vehicles. An asterisk before a subject group indicates additional types of vehicles to which the indicated standards may apply.

/1 Brake Systems (102, 105-6, 116)	
* /2 Buses, School Buses, and Multipurpose Passenger Vehicles (102-4, 106-8, 111-3, 116, 205-6, 209, 211)	
* /3 Cycles (3; 108, 112, 116, 205)	
/4 Design (14; 101-2, 105, 107, 201)	
/5 Door Systems (201, 206)	
/6 Fuel Systems (101, 301)	
/7 Glazing Materials (205)	
/8 Hood Latch Systems (113)	
/9 Inspection (1)	
/10 Lighting Systems (101, 105, 108, 112)	
/11 Maintenance and Repairs	
/12 Manufacturers, Distributors, and Dealers	
/13 Mirrors and Mountings (107, 111)	
/14 Occupant Protection (15; 201-4, 207-10)	
/15 Propulsion Systems	
/16 Registration (2, 10)	
/17 Safety Defect Control	
/18 Steering Control System (101, 107, 203-4)	
/19 Theft Protection (114-5)	
* /20 Trucks and Trailers (102-4, 107-8, 112-3, 116, 205-6, 209)	
/21 Used Vehicles	
/22 Wheel Systems (109-10, 211)	
/23 Windshield-Related Systems (101, 103-4, 107, 205, 212)	

NHTSA DOCUMENTS	20
EXECUTIVE SUMMARIES	-

NOTE: Material published in Highway Safety Literature (HSL) is intended for the information and assistance of the motor vehicle and highway safety community. While brand names, equipment model names and identification, and companies may be mentioned from time to time, this data is included as an information service. Inclusion of this information in the HSL should not, under any circumstances, be construed as an endorsement or an approval of any particular product, course, or equipment by the U.S. Department of Transportation, National Highway Traffic Safety Administration.

Harry A. Feinberg
Managing Editor

AVAILABILITY OF DOCUMENTS AND INSTRUCTIONS FOR ORDERING

Articles and reports whose citations and abstracts appear in HSL are acquired from many sources, such as periodicals, journals, NHTSA Contractors' reports and NHTSA staff speeches, and other reports. Those reports other than NHTSA Contractors' reports and NHTSA generated reports and speeches (see introduction) are assigned a lower consecutive accession (HS-) number.

Department of Transportation personnel may borrow copies of publications announced in HSL from the NHTSA Technical Reference Division. Non-DOT Personnel, in the Washington, D.C. area, may borrow copies of publications for a 24-hour period only. Telephone (202) 426-2768. Government personnel in the Washington, D.C. area, use government ID phone 118-62768.

The names of the journals cited in HSL appear in *italic type* preceded by the words "Published in." The journal containing the article cited may be borrowed from most research and public libraries. Non-DOT personnel outside the Washington area should contact their company or agency libraries for assistance.

NHTSA Contractors' reports and other reports can usually be obtained as indicated under AVAILABILITY. However, there is no certainty that copies will be available for more than a limited period after a report is issued.

The more common availability sources are identified by symbols which are explained in the next column:

NTIS: National Technical Information Service, Springfield, Va. 22151. Order by accession number: HS, AD, or PB. Prepayment is required by NTIS coupon (GPO coupons are not acceptable), check or money order (made payable to the NTIS). PC (Paper copy; full size original or reduced facsimile) prices are \$3.00 up to 300 pages, \$6.00 for 301 to 600 pages, \$9.00 for 601 to 900 pages, and over 900 pages will be quoted on request. Surcharge is added for foreign orders. MF (microfiche approximately 4x6" negative sheet film; reader required) is \$0.95 per report.

GPO: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Give corporate author, title, personal author, and report number. Prepayment is required by GPO coupon (NTIS coupons are not acceptable), check or money order (made payable to the Superintendent of Documents).

HRB: Highway Research Board, National Academy of Sciences, 2101 Constitution Ave., N. W., Washington, D. C. 20418.

NHTSA: National Highway Traffic Safety Administration, General Services Division, Washington, D.C. 20591 (Telephone (202) 426-0874), Give HS-No.

SAE: Society of Automotive Engineers, Dept. HSL, 2 Pennsylvania Plaza, New York, N.Y. 10001. Order by SAE report numbers. Prices given are list; discounts are available to SAE members and sometimes to libraries and U.S. Government Agencies. Prepayment is required; orders received without payment are subject to a \$1 handling charge.

IMPORTANT NOTICE

WHEN REQUESTING a document, to be absolutely sure you receive what you order, give the accession number (HS, PB, AD number) or report number (in cases such as an SAE document), title of report, and the personal or corporate author (whichever is cited). When requesting an HS-numbered document from NTIS, add DOT/to the prefix HS-; example HS-800 000 should be ordered as DOT/HS-800 000.

1/0 ACCIDENTS

1/1 Emergency Services

HS-010 880 Fld. 1/1

EMERGENCY MEDICAL CARE SYSTEMS

by Alan M. Nahum

Published in *Journal of the American Medical Association* v217 n11 p1530-2 (13 Sep 1971)

Improving a medical care system requires an understanding of input and output functions and how they are achieved. Changes should be preceded by the establishment of a data system that will produce accurate measurements before and after change so that evaluation is possible. An initial approach, once measurement techniques have been established, would be to conduct a pilot study on an isolatable portion of the system. This might be beneficial when dealing with large urban systems but, perhaps, unnecessary for smaller rural or suburban systems. Changes will depend upon public pressure for improvement and availability of funds to meet the costs of preserving life and good health.

Search terms: Emergency medical services; Systems analysis

1/2 Injuries

HS-010 881 Fld. 1/2

A SURVEY OF INJURIES TO THE LIVER AND SPLEEN IN FORENSIC AUTOPSIES

by D. A. L. Bowen

Published in *Journal of Forensic Medicine* v17 n1 p12-19 (Jan-Mar 1970)

13 refs

The incidence of injuries to the liver and spleen in a series of 914 medico-legal

autopsies is given. Most of these injuries followed fatal road accidents, the remainder followed falls from a height and injuries sustained on the railroad track. The problems of delayed rupture of the spleen and the battered child syndrome are also mentioned.

Search terms: Splenic injuries; Autopsies; Liver injuries; Abdominal injuries; Pedestrian injuries; Passenger injuries; Motorcycle operator injuries; Driver injuries; Bicycle rider injuries; Splenic rupture; Age factor in accidents; Sex factor in accidents

HS-010 882 Fld. 1/2

A SURVEY OF CURRENT HEAD INJURY RESEARCH

by A. Earl Walker; J. Kiffin Penry; David E. Goldman; Alexander T. Ross; Anthonie Van Harreveld; Abner Wolf

National Advis. Neuro. 'Diseases & Stroke Council

1969 62p 420 refs

The major objectives of this study on head injury research are: determining what investigators are currently performing head injury research, specific areas currently being investigated; sources, amounts, and types of funding of current head injury projects; overlapping areas of research involving unnecessary duplications; and neglected areas where more research emphasis could be applied. The study revealed the need for more information on head injuries in all areas. There appeared to be no unnecessary duplication of efforts but a need to provide more support in head injury investigation. Projects are summarized by areas of research: biomechanical aspects; accident investigation teams; basic pathophysiologic mechanisms; sequelae of injury; clinical centers; diagnosis; and treatment.

Search terms: Head injuries; Brain injuries; Pathology; Reviews; Medical treatment; Diagnosis; Financing; Head protection; Injury research; Grants; Biomechanics; Accident investigation; Multidisciplinary teams

HS-010 883 Fld. 1/2

SNOWMOBILE ACCIDENTS: A REVIEW OF INJURIES SUSTAINED IN THE USE OF SNOWMOBILES IN NORTHERN NEW ENGLAND DURING THE 1968-69 SEASON

by Richard L. Withington; Leland W. Hall

Published in *Journal of Trauma* v10 n9 p760-3 (Sep 1970)

7 refs

Snowmobile injuries closely resemble those observed in motorcycle accidents, except that they may be complicated by exposure to severe cold and by inaccessibility. Crash helmets on snowmobilers may be as important as on motorcyclists. Prevention of snowmobile accidents can be accomplished by a triple assault: safety features must be incorporated into the design of snowmobiles; better legislation to regulate the use of snowmobiles and to improve reporting of accidents must be enacted; snowmobile users must be made aware of the dangerous characteristics of the sport in order to avoid accidents. Five case reports are given, involving severe spinal and head injuries resulting in permanent disability.

Search terms: Snowmobile caused injuries; Accident reports; New England States; Injury case reports; Spinal injuries; Head injuries; Fractures; Snowmobile accidents; Snowmobile design; Injury severity; Accident studies; Helmets

1/3 Investigation

HS-010 884 Fld. 1/3; 1/2

INVESTIGATION OF AUTOMOTIVE MISHAPS IN FRONTENAC COUNTY (ONTARIO)

by W. R. Ghent; Brian E. Good; M. Neil McCrank; Bruce Pritchard; Thomas Todd

Published in *Canadian Journal of Surgery* v13 p236-42 (Jul 1970)

9 refs

Summary in French.

A research crew studied 31 accidents, 16 of which involved fatalities. These 31 accidents involved 23 fatalities and 88 more persons injured. Head injuries were the leading cause of death. Nine of the 16 fatalities were single vehicle accidents. Among the factors studied were the relationship between barometric pressure and accident rate; driver failure; vehicle failure; accident location; driver age. Methods used in the accident study are discussed.

Search terms: Multidisciplinary teams; Accident research; Accident investigation; Fatalities; Accident location; Autopsies; Head injuries; Single vehicle accidents; Fatality causes; Accident rates; Accident causes; Ontario; Driver error caused accidents; Driver age; Failure caused accidents; Environmental factors; Accident studies; Accident factors; Head injuries

HS-010 885 Fld. 1/3; 3/4

COUNTERMEASURES IN TRAFFIC SAFETY: AN OVERVIEW

by Roger E. Hagen

Published as Chapter 2 of *Injury Control in Traffic Safety*, Springfield, 1970, p23-48

refs

There are two broad classifications of countermeasure techniques: those designed to modify the environment, and those that modify behavior. Environmental countermeasures include operator packaging, vehicle detection and information systems, road improvement, traffic control, pedestrian protection, enforcement, and inspection. Behavioral countermeasures include child training, mass media, and personal communication and group techniques. This chapter is concerned with these countermeasures as well as some general guidelines for the development and evaluation of countermeasure programs.

Search terms: Accident prevention; Injury prevention; Occupant protection; Vehicle visibility; Highway communication; Signal lamps; Electronic Route Guidance System; Crashworthiness; Driver behavior; Driver attitudes; Highway design; Safety design; Safety program effectiveness; Pedestrian safety; Vehicle inspection; Child safety education; Public information programs; Police traffic services

1/5 Statistical data

HS-010 886 Fld. 1/5; 1/3

TRAFIKOLYCKORNAS SAMBAND MED TRAFIKMILJON. ANALYS AV TRAFIKOLYCKOR PA SVENSKA MOTORVAGAR 1956 - 1967 (RELATION BETWEEN ROAD ACCIDENTS AND THE ENVIRONMENT. ANALYSIS OF TRAFFIC ACCIDENTS ON SWEDISH MOTORWAYS 1956-1967)

Chalmers Tekniska Hogskola (Sweden)

1970 160p 19 refs
Report no. 31-1970

Includes English summary.

An investigation was made to determine the traffic safety quality of Swedish motorways through a survey of accident rates and analysis of single and multiple

relations between accidents and variables of the milieu. The study includes 1,936 accidents which took place in left hand traffic at six kinds of locations. Sixteen conclusions are given relating the accidents to highway design, time of day, traffic volume, type of vehicle, and severity of accidents and injuries. Measures suggested for improvement of road safety are improved highway design and maintenance, local speed limits, and improved driver education.

Search terms: Accident studies; Accident factors; Accident location; Accident rates; Accident statistics; Accident types; Accident investigation; Freeways; Left hand vs right hand driving; Fatality rates; Sweden; Speed limits; Highway design; Time of day; Traffic volume; Accident severity; Injury severity; Highway maintenance; Environmental factors

HS-010 887 Fld. 1/5; 2/7

THE EFFECT OF SALT ON THE NUMBER OF WINTER ACCIDENTS

by Ernest Stephen Arvai

Published in *HIT Lab Reports* p9-11 (Jan 1971)

A study was made to correlate the use of salt for melting ice and the accident rates recorded in two files which are coded by season and weather conditions. Two apparently contradictory results were found. Linear regression analysis showed that the percentage of accidents on icy roads decreased with salt usage, but the decrease in the number of accidents became smaller with increased salt usage. The data in the second file indicated that salt reduces accidents on ice but seems to increase the overall accident rate. It was impossible to draw a conclusion from the results of the study.

Search terms: Winter driving; Icy road conditions; Winter accidents; Accident rates; Salts effects; Accident studies; Linear regression analysis

2/0 HIGHWAY SAFETY

2/1 Breakaway Structures

HS-010 888 Fld. 2/1

DEVELOPMENT OF BREAKAWAY SIGN SUPPORTS AND SLOTTED STEEL PLATE MECHANICAL FUSES. FINAL REPORT

by Neilon J. Rowan; Robert M. Olson; Monroe C. White

Texas A and M Univ. Texas Transp. Inst.; Texas Hwy. Dept.

1968 23p 5 refs
Report no. PB-185 070; RR-68-4

Prepared in cooperation with the Bureau of Public Roads.

Test data are presented on a modification of the original breakaway design, replacing the cast iron plate with a slotted steel plate to avoid premature, noncollision fractures. Tests of simulated wind load failure before and after collision replacement, and of effects of weatherings showed that adequate performance was retained.

Search terms: Breakaway sign supports; Roadside hazards; Fixed objects; Static tests; Slotted plates; Guardrail impact tests; Wind forces; Weather resistance; Tensile strength; Coefficient of friction; Slip

AVAILABILITY: NTIS as PB-185 070

2/4 Design and Construction

HS-010 889 Fld. 2/4

DYNAMIC TESTS OF THE CALIFORNIA TYPE 20 BRIDGE BARRIER RAIL

by Eric F. Nordlin; James H. Woodstrom; Raymond P. Hackett; J. Jay Folsom

Published in *Highway Research Record* n343 p57-74 (1971)

11 refs

Sponsored by Committee on Traffic Safety Barriers and Signs, Signal and Lighting Supports and Committee on Bridge Design and presented at the 50th annual meeting of Highway Research Board.

Five full-scale impact tests were run against the bridge rail system, a rigid structure of contoured concrete with a steel tube rail. The test results indicated that this system will retain and redirect a 4,900 pound passenger vehicle impacting at speeds up to 65 mph and at angles of from 7 to 25 degrees with the barrier. Vehicle damage varied from negligible at a 7 degree impact angle to severe at a 25 degree impact angle. The test results indicated that the vehicular decelerations sustained during 25 degree, 65 mph impacts into this system will result in occupant injuries varying from severe, if no restraints are used, to no more than moderate, if both a seat belt and a single diagonal shoulder harness are used.

Search terms: Bridge parapet design; Guardrail design; Guardrail impact tests; Barrier impact forces; Accelerometers; Dynamic tests; Impact angle; Barrier collision tests; Instrumented vehicles; Injury severity; High speed

HS-010 890 Fld. 2/4

DYNAMIC EVALUATION OF TIMBER POSTS FOR HIGHWAY GUARDRAILS

by Jarvis D. Michie; Charles J. Gatchell; Theodore J. Duke

Published in *Highway Research Record* n343 p19-33 (1971)

1 ref

Sponsored by Committee on Traffic Safety Barriers and Signs, Signal and

Lighting Supports and presented at the 50th annual meeting of the Highway Research Board.

A special pendulum impact facility was used to subject test specimens to dynamic loading that simulated a vehicle-guardrail installation collision. One hundred specimens of Douglas fir, southern pine, red oak, and red pine wood were evaluated; for comparison 6B8.5 and 315.7 steel members were tested. Test results show that, while data scatter exist within a wood species and size test group, the average values of such groups can be plotted in a manner to give meaningful trends. Peak force, average force, and fracture energy are shown to be direct and linear functions of moment of inertia.

Search terms: Guardrail posts; Guardrail design; Wood; Guardrail impact tests; Steels; Pendulum tests; Fracture mechanics; Mathematical analysis; Breaking energy; Dynamic tests; Barrier impact forces

HS-010 891 Fld. 2/4

WATER-PLASTIC CRASH ATTENUATION SYSTEM: TEST PERFORMANCE AND MODEL PREDICTION

by Charles Y. Warner; Joseph C. Free

Published in *Highway Research Record* n343 p83-92 (1971)

7 refs

Sponsored by the Committee on Traffic Safety Barriers and Signs, Signal and Lighting Supports and presented at the 50th annual meeting of the Highway Research Board.

A digital computer model was constructed to represent the dynamic response of the Hi-Dro Cushion Cell Barrier. The model was verified by comparing with actual full scale tests. The verified model was then exercised to

2/4 Design and Construction (Cont'd.)

HS-010 891 (Cont'd.)

provide prediction of response to extremes of vehicle mass and speed. Predictions show that the water-plastic unit provides good performance across the spectrum of impacting vehicle momenta, and that it provides a response that takes advantage of almost all the available stopping distance for impacts between 30 and 70 mph, employing vehicles weighing from 2,000 to 6,000 pounds.

Search terms: Computerized simulation; Mathematical models; Barrier impact forces; Energy absorbing barriers; Hydraulic barriers; Model tests; Simulation models; Impact attenuators; Water cushions; Barrier tests; Crash cushions; Stopping distance; Plastics

HS-010 892 Fld. 2/4

CRASH TEST PERFORMANCE OF A PROTOTYPE LIGHT-WEIGHT CONCRETE ENERGY-ABSORBING GUARDRAIL SYSTEM

by Charles Y. Warner; Grant W. Walker

Published in *Highway Research Record* n343 p13-8 (1971)

4 refs

Sponsored by Committee on Traffic Safety Barriers and Sign, Signal and Lighting Supports and presented at the 50th annual meeting of the Highway Research Board.

This paper presents the results of a series of crash tests that compare the performance of standard G4 guardrail with that of a similar guardrail equipped with energy-absorbing cartridges constructed of lightweight concrete. Test results indicate that the cartridges can reduce acceleration loads on vehicles by 20 to

30%, improve resistance to pocketing and overriding, and reduce maintenance costs in some instances. Cartridge design is compatible with existing hardware and is adaptable to special needs. The low cost of the cartridges suggests a favorable cost-benefit ratio.

Search terms: Guardrail design; Guardrail impact tests; Concrete guardrails; Energy absorbing barriers; Loads (forces)

HS-010 893 Fld. 2/4

SCALE-MODEL TEST OF AN ENERGY-ABSORBING BARRIER

by Richard J. Fay; Edward P. Wittrock

Published in *Highway Research Record* n343 p75-82 (1971)

3 refs

Sponsored by Committee on Traffic Safety Barriers and Sign, Signal and Lighting Supports and presented at the 50th annual meeting of the Highway Research Board.

A scale-model test of the "Texas barrel barrier" was conducted to demonstrate the great utility of scale modeling in the study of energy-absorbing highway barriers. This barrier consists of an array of empty 55-gal drums attached together and fastened in place so that energy from an impacting automobile is absorbed in the plastic deformation of the drums. The model test results were found to agree very well with results from a full-scale test. The modeling techniques are presented, and the similitude requirements for the scale modeling of the car and the barrier are developed.

Search terms: Scale models; Barrier impact forces; Energy absorbing barriers; Drums; Barrels; Simulation models; Impact attenuators; Barrier tests

HS-010 894 Fld. 2/4; 2/1

EVALUATION OF TIMBER WEAK-POST GUARDRAIL SYSTEMS

by Maurice E. Bronstad; Robert B. Burket

Published in *Highway Research Record* n343 p34-56 (1971)

3 refs

Sponsored by Committee on Traffic Safety Barriers and Sign, Signal and Lighting Supports and presented at the 50th annual meeting of the Highway Research Board.

Six full-scale vehicle crash tests were conducted on guardrail systems to evaluate the effectiveness of substituting timber posts for standard 315.7 steel posts. Results of the tests indicate that timber is a suitable post material for the weak-post concept. A one-fourth inch diameter steel bolt and a pipe insert provide proper attachment of rail to post. The sixth test of the series provided an evaluation of the effectiveness of a continuous installation composed of the new timber weak-post system and the strong-post system. The transition design between the two systems was satisfactory, but design changes could improve performance. Modification by notching is recommended for existing wood strong-post systems.

Search terms: Guardrail posts; Guardrail design; Wood; Steels; Breakaway structures; Guardrail impact tests; Barrier impact forces

HS-010 895 Fld. 2/4; 4/5

GENERAL COMPUTER PROGRAM FOR ANALYSIS OF AUTOMOBILE BARRIERS

by Graham H. Powell

Published in *Highway Research Record* n343 p1-12 (1971)

4 refs

Sponsored by Committee on Traffic Safety Barriers and Sign, Signal and Lighting Supports and presented at the 50th annual meeting of the Highway Research Board.

The barrier is idealized as a structural framework of arbitrary configuration and the colliding automobile as a body surrounded by a cushion of springs. Large displacements and inelastic behavior, including hysteresis effects on unloading, are considered in the barrier structure. The automobile slides along the barrier, and the effects of normal forces, friction forces, and wheel drag forces are considered in determining its motion. Input data to the program consist of the configuration of the barrier, the properties of the barrier members and automobile, and the trajectory of the automobile before impact. Output consists of time histories of automobile positions, velocities and accelerations, barrier deflections, and barrier member forces. Examples are given of calculations.

Search terms: Mathematical models; Computerized simulation; Barrier design; Simulation models; Computer programs; Barrier impact forces; Barrier tests

HS-010 896 Fld. 2/4; 4/5

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS COMMITTEE ON ELECTRONICS NATIONAL CONFERENCE, MAY 7-8, 1968. PROCEEDINGS

by L. S. Larsen; A. E. Johnson; Gale W. Cleven; Mario Marques; Larry G. Walker; Samuel A. Wigon; H. A. Henry; C. A. Howard; Philip R. Miller; I. W. Morehouse; George S. Eakin; F. Eldon Rickman; Charles E. Carlson; Donald A. Maxwell; Gene Mangum

American Assoc. of State Hwy. Officials

1968 212p

Report no. PB-184 068

Prepared in cooperation with Bureau of Public Roads and the Texas Hwy. Dept.

Representatives from state highway departments and industry, as well as specialists from the Bureau of Public Roads, presented papers and participated in panel discussions on the uses of applied electronics in highway engineering, administration, and research. Most papers dealt with electronic computer applications, data processing and transmission, and such related techniques as programming, time sharing, automation in engineering design, and electronic control for traffic systems. Other papers reported on progress in the development of the TIES (Total Integrated Engineering System).

Search terms: Traffic volume; Computerized highway engineering techniques; Conferences; Programming; Computerized design; Computerized records management; Data processing; Time sharing; Right of way (land); Traffic research; Total Integrated Engineering System; Traffic flow; Traffic surveillance; Highway planning; Highway design; History; Automatic traffic control; Drainage; Bridge design; State highway departments; Federal aid; Flow charts; Surface drainage; New York (State); Texas; Minnesota; Computer programs; Maryland; Wyoming

AVAILABILITY: NTIS AS PB-184 068

2/8 Police Traffic Services

HS-010 897 Fld. 2/8

HOW FLINT CUT ITS TRAFFIC TOLL

Anonymous

Published in *Journal of American Insurance* v47 n4 p22-4 (Sep/Oct 1971)

Selective enforcement made Flint, Michigan, a safer city. In October 1969, Flint had been in tenth place for cities its size with 2.6 fatalities per 10,000 vehicles registered; by January 1971 the rate was down 61% to 1.0 per 10,000. A grant from the NHTSA of \$387,000 started the program enabling the Flint Police Department to hire 28 new officers. Men are assigned in concentrated areas according to the previous month's accident locations and hours, and they are encouraged to make stops for minor violations. Other cities will soon try selective enforcement under similar federally funded projects.

Search terms: Fatality rates; Accident prevention; Police traffic services; Manpower utilization; Law enforcement effect on accident rates; Accident rates; Federal aid; Grants; Michigan

2/9 Traffic Control

HS-010 898 Fld. 2/9

THE MARCONI/R.R.L. VEHICLE DETECTOR

by D. L. Swale; M. G. Ginn

Published in *Traffic Engineering and Control* v11 n6 p268-72 (Oct 1969)

5 refs

A new form of vehicle detector is described. Its development results from cooperative research by the Road Research Laboratory and the Marconi Company. The result is a very versatile detector, operating on a triboelectric principle and capable of performing a number of different traffic management tasks. More than 30 experimental detectors have been installed in public roads in Great Britain to provide performance data under varying conditions of use and to evaluate the device as a possible replacement for both pneumatic tubes and other forms of detector.

2/9 Traffic Control (Cont'd.)**HS-010 898 (Cont'd.)**

Search terms: Vehicle detectors; Great Britain; Performance tests

HS-010 899 Fld. 2/9**ELECTROMAGNETIC LOOP VEHICLE DETECTORS**

by Robert L. Anderson

Published in *IEEE Transactions on Vehicular Technology* vVT-19 n1 p23-30 (Feb 1970)

5 refs

Three different electromagnetic loop vehicle detector designs are described: self-tuning, bridge-balance, and phase-shift. Principles of operation, design limitations, and design tradeoffs for each method are presented in detail. The characteristics of the lead-in wire used are shown to be the primary limitation in loop detector performance and stability. Characteristics of commercially available wire used in present-day loop detector installations are discussed. Design equations and graphs illustrate the tradeoff considerations in the determination of optimum loop configuration and inductance.

Search terms: Magnetic loop detectors; Vehicle detectors; Electronic traffic control

HS-010 900 Fld. 2/9**SAFER LEFT TURN SIGNING**

Jean Granger; Nguyen Quang Quy

Published in *Traffic Engineering* v41 n12 p37-40 (Sep 1971)

A new system of left turn signing uses a dashed white arrow on green background near the signal to give protected turns, to

prevent delayed drivers from using dangerously short gaps. Opposing traffic is warned by signs and a pair of alternately flashing red balls, similar to railroad crossing signals. A test site in Montreal was observed with video camera equipment, supplemented by roadside interviews. Analyses showed a 50% decrease in stop line violations and a six-to-one decrease in false starts.

Search terms: Left turn signals; Left turn signs; Montreal; Gap acceptance; Sign tests; Signal tests

HS-010 901 Fld. 2/9; 4/8**ADVANCES TOWARD THE AUTOMATIC HIGHWAY**

by R. E. Fenton; K. W. Olson; J. G. Bender

Published in *Highway Research Record* n344 p1-20 (1971)

28 refs

Sponsored by the Committee on Vehicle Characteristics and presented at the 50th annual meeting of the Highway Research Board.

A considerable improvement in both highway capacity and safety can be achieved by highway automation. One design for such automation, which involves a dual-mode system whereby a vehicle is manually controlled on nonautomated roads and automatically controlled on automated ones, is described. A progress report on various experimental studies relevant to this design is presented. A suggested partial solution that resulted in successful vehicle automatic steering at high speeds on the interstate highway is presented. A scheme for automatic vehicle longitudinal control is outlined, and typical test data from lead car overtaking and emergency braking studies are given. Results of a continuing study of automatic merging are presented, and an

approach to improving the performance of the driver-vehicle system during the interim period between nonautomated and fully automated highways is discussed.

Search terms: Automatic highways; Automatic control; Guidance systems; Car following; Mathematical models; Dual mode vehicles; Vehicle control; Merging; Automatic steering control; High speed; Overtaking; Braking; Automatic speed control

3/0 HUMAN FACTORS**3/1 Alcohol****HS-010 902 Fld. 3/1****DOES DRINK MEAN DRUNK? LOOKING AT BLOOD ALCOHOL LEVELS**

by A. H. Beckett; M. Mitchard; A. Saunders

Published in *Autocar* v135 n3934 p34-5 (19 Aug 1971)

The effects of body weight, food consumption, and time factors on blood alcohol levels are explained.

Search terms: Alcohol usage; Drinking drivers; Blood alcohol levels; Alcohol effects; Metabolism; Human body weight; Food; Time factors

HS-010 903 Fld. 3/1**ANALYSING FOR ALCOHOL**

by R. C. Denney

Published in *Chemistry in Britain* v6 p533-5 (Dec 1970)

13 refs

The Road Safety Act, 1967, introduced the breath test and attendant analyses of

blood and urine samples in Great Britain. The breath test, chemical analysis of alcohol levels in blood and urine, and the gas chromatographic method are reviewed. It is concluded that the analytical chemist has a very responsible part to play in the smooth and effective operation of the Road Safety Act.

Search terms: Road Safety Act of 1967 (Great Britain); Alcohol chemical tests; Blood alcohol levels; Urine alcohol levels; Alcohol breath tests; Breathalyzers; Alcohol blood tests; Drinking driver evidence; Gas chromatography

HS-010 904 Fld. 3/1

THE BLOOD ALCOHOL DISTRIBUTION IN DRIVERS NOT INVOLVED IN ACCIDENTS

by Richard Zylman

Published in *Quarterly Journal of Studies on Alcohol* v32 n1 p188-90 (Mar 1971)

19 refs

R. G. Smart and W. Schmidt have made several studies on drinking drivers and blood alcohol levels and concluded that there was no sharp dividing line between high and low blood alcohol levels. P. M. Hurst, studying the same data, concluded that there was a definite break in the curve relating blood alcohol concentration to collision involvement and that the higher levels were associated with more severe accidents. Differing conclusions lead to differing recommendations for the control of drinking drivers. The conclusions of Smart and Schmidt are criticized.

Search terms: Blood alcohol levels; Drinking drivers; Driver intoxication; Statistical analysis; Alcohol usage deterrents; Accident severity; Accident factors

3/4 Driver Behavior

HS-010 905 Fld. 3/4

DRIVER-ERROR BEHIND 85 PERCENT OF WRECKS

by Carl Wagner

Published in *Fleet Management News* v27 p8-11 (Apr 1971)

This is the final installment of a three-part review of the book *The Other Side of the Story* by Samuel J. Lee. It is suggested that emphasis on vehicle defects will not solve the highway safety problem and that human factors need more attention. Problems mentioned are impaired drivers, alcohol and drug abuse, poor auto maintenance, and federal control.

Search terms: Human factors; Federal control; Driver error caused accidents; Driver physical fitness; Drinking drivers; Drug addiction; Automobile maintenance; Defective vehicles

HS-010 906 Fld. 3/4

A DRIVING TASK ANALYSIS

by Vernon S. Ellingstad

Published as chapter 8 of *Injury Control in Traffic Safety*, Springfield, 1970 p176-200

36 refs

An analysis and literature review of the driver subsystem, which provides the interface between vehicle and highway, is given. Driver effectiveness is a result of the physical and mental status of the driver, and of actual performance in the driving task. Physical status determinants are: sensory processes, sensor-effector coordination, and tolerance to transient effects such as fatigue, drugs, and noise. Other components of driver effectiveness are: attitude, motivation, psychomotor skills, and experience. Driver performance consists of search and scan, perceptual, decision making, and physical response tasks. These are performed in

the context of the vehicle and highway-traffic subsystems.

Search terms: Driver vehicle road interfaces; Driver behavior; Driving task analysis; Driver performance; Driver skills; Man machine systems; Perceptual analysis; Visual perception; Search performance; Velocity perception; Passing; Risk taking; Decision making; Driver reaction time; Driver attitudes; Driver experience; Human factors engineering; Automobile interior design

HS-010 907 Fld. 3/4

NATIONAL DRIVER SURVEY—ASLEEP AT THE WHEEL

by Barbara Ford

Published in *Science Digest* v70 n1 p36-43 (Jul 1971)

A synopsis of current and past research on narcolepsy and highway hypnosis is given. Suggestions are given to ward off sleepiness behind the wheel and a questionnaire is included for drivers who want to participate in a survey on sleepy drivers.

Search terms: Driver fatigue; Highway hypnosis; Narcolepsy; Attention lapses; Sleep; Questionnaires

HS-010 908 Fld. 3/4; 2/9

INFORMATIONEN IN HAMTNING I KORSNINGAR. 2. FORARBETE ENDEN I SIGNAL-REGLERADE KORSNINGAR PA TYCHO HEDENS VAG, UPPSALA 1970. (DRIVER BEHAVIOR AT SIGNALIZED INTERSECTIONS ON THE ROAD TYCHO HEDENS VAG IN UPPSALA 1970)

Chalmers Tekniska Hogskola (Sweden)

1971 74p 19 refs
Report no. 33-1971

Includes English summary.

3/4 Driver Behavior (Cont'd.)**HS-010 908 (Cont'd.)**

The object of this study was to examine what mental effort the traffic environment requires. The driver's ability to perceive correctly the distance to oncoming vehicles in connection with left turning and to observe traffic signals at the right moment and in a correct way was studied. It was concluded that drivers estimate speed and distance in unfavorable conditions, chiefly due to the straight road and the placing of lighting posts on both sides. It is especially difficult in the dark to determine whether a light source is on or beside the road. Gap acceptance was studied and it was found that 19% of drivers exceeded the speed limit when crossing a particular intersection. Recommendations are made for reducing traffic volume, reducing conflicts and confusion, raising driver attention, improving traffic control devices, and installing barriers.

Search terms: Driver behavior; Driving conditions; Highway improvements; Intersections; Traffic control devices; Driver confusion; Gap acceptance; Traffic conflicts; Highway lighting; Distance perception; Pavement markings; Velocity perception; Sweden; Left turns; Median barriers; Traffic signal recognition; Signalized intersections; Driving task analysis; Night driving; Oncoming vehicles; Speed patterns

HS-010 909 Fld. 3/4; 3/5**EXPERIMENTAL APPROACHES AND HARDWARE FOR DRIVING RESEARCH**

by Thomas R. Schori

Published as Chapter 7 of *Injury Control in Traffic Safety*, Springfield, 1970 p154-75

31 refs

The indirect approach to driver behavior research attempts to apply to the driving situation pertinent findings from other research on human input, central processing, and output operations. In the direct approach, actual driver behavior is studied on the road or in the laboratory. Although the validity of simulation has been questioned, laboratory methods offer more safety, expanded scope, better experimental control, and savings of time. Techniques and equipment include instrumented vehicles, and whole-task or part-task simulators based on television, point light sources, direct optical viewing, and motion pictures.

Search terms: Driver behavior; Driver performance; Perceptual analysis; Motor skills; Driving simulators; Driving tasks; Research methods; Road tests; Highway Systems Research Car; Driving simulation research

3/5 Driver Education**HS-010 910 Fld. 3/5****DRIVER EDUCATION AND IMPROVEMENT PROGRAMS**

by James L. Nichols

Published as Chapter 3 of *Injury Control in Traffic Safety*, Springfield, 1970 p49-87

78 refs

This paper reviews the studies on driver education effectiveness and the increasing questioning of these study results. Issues in high-school driver education discussed are: teacher preparation and certification; course standardization and content; accident-avoidance training; time relegation; adult driver education; motorcycle training; and training for the handicapped and elderly. Commercial driver education and various driver improvement programs are also discussed.

Search terms: Driver education; Driver education evaluation; High school driving courses; Commercial driving schools; Professional drivers; Instructor training; Curricula; Accident prevention; Defensive driving; Problem drivers; Driver characteristics; Driver records; Motorcycle operator education; Driver improvement

HS-010 911 Fld. 3/5**FOR BETTER DRIVERS: TEACH THEM BEFORE THEY START**

Insurance Inst. for Hwy. Safety

1968 10p

The Highway Safety Act of 1966 requires each state to include driver education in its highway safety program. Criteria for a good high school driver education program are outlined. The course should be more than mere training. Minimum requirements for course content and teacher qualifications are listed. Most driver education programs need improvement.

Search terms: Driver education; High school driving courses; Highway Safety Act of 1966; Curricula; Instructors; Driver education evaluation; Driver education standards; Behind the wheel instruction; Classroom driver instruction

HS-010 912 Fld. 3/5; 2/8**EDUCATED FOR EMERGENCY**

by James Brescoll

Published in *California Highway Patrolman* v35 n7 p38, 40-1, 44-5 (Sep 1971)

The California Highway Patrol Academy cadets spend 22 of the 860 training hours in vehicle operations. The objective is to provide training in the areas of vehicle limitation, roadway and

traffic hazards, recognition of accident traps, conditioning of reflexes, and swift decision making. The training includes driving on skid pans, high speed driving, and defensive driving.

Search terms: Police training; Skid pans; Automobile driving ranges; California; Defensive driving; High speed

HS-010 913 Fld. 3/5; 3/6; 4/2

PROBLEMS AND ISSUES IN TRAFFIC SAFETY RESEARCH

by Norman W. Heimstra

Published as chapter 1 of *Injury Control in Traffic Safety*, Springfield, 1970 p3-22

5 refs

There is no single explanation for the fact that the problem of traffic accidents has not been subject to proper research. It is due to a variety of causes ranging from public attitudes and understanding of accidents to general problems associated with conducting adequate research in this area. Problems are discussed at length, and the issues are defined as countermeasure approaches, driver education, driver licensing, drinking drivers, attitudes and driving, and methodology.

Search terms: Highway safety; Safety research; Public opinion; Accident prevention; Driver attitudes; Driver education; Drinking drivers; Research methods; Financing; Personnel management; Driver licensing

3/6 Driver Licensing

HS-010 914 Fld. 3/6

AN EXPERIMENT IN THE USE OF A DRIVING SIMULATOR AS A LICENSE TESTING DEVICE. PUBLIC REACTION TO SIMULATOR TESTING. PROGRESS REPORT

by John F. O'Brien; Louise Kuziomko

New York (State) Dept. of Motor Vehicles

1971 24p

Cover title: *A Report on Public Response to the Use of the Driving Simulator for Driver License Testing*

A driving simulator was evaluated as a license testing device by volunteer driver license applicants. The test group of 595 included both license applicants and their accompanying licensed drivers. Following the simulator test, a questionnaire was presented to all subjects. Equipment failure prevented completion of the evaluation of the simulator as a testing device. Analysis of questionnaire results indicated that 54% of the subjects felt the simulator test was a good way of determining driving ability. When asked if they would prefer to take their entire driving test on a simulator, 92.3% of the test group answered in the negative. Questionnaire results indicate that there should be little difficulty in obtaining public acceptance of simulator testing if it is used as a supplement to other testing methods. Further evaluation of the simulator as a testing device is intended. Males and experienced drivers reacted more favorably to the test than females and inexperienced drivers.

Search terms: Driver tests; Driving simulators; New York (State); Test volunteers; Driver license examination; Driver attitudes; Male drivers; Female drivers; Driver experience; Age factor in driving; Driver age

HS-010 915 Fld. 3/6; 3/9; 3/4

DRIVER LICENSING AND SELECTION: CURRENT SHORTCOMINGS AND RESEARCH ISSUES

by Kent A. Kimball

Published as chapter 4 of *Injury Control in Traffic Safety*, Springfield, 1970, p88-107

35 refs

The potential of licensing and selection procedures as a countermeasure to traffic accidents has not been developed. Possible reasons for this are basic changes in the philosophy of accident causation and fear of hostile public sentiment. Research findings on which to base changes in state programs are needed in the following fields: licensing and nonuniformity; medically impaired drivers; aging drivers; other problem drivers, including negligent and alcoholic drivers. Pros and cons of issues involved and possible research approaches are discussed.

Search terms: Driver licensing; Accident prevention; Safety program effectiveness; Driver license standards; Driver license examination; Driver mental fitness; Driver physical fitness; Aged drivers; Drinking drivers; Problem drivers; Law uniformity; Handicapped drivers; Driver records; Negligence; Suicide by vehicle; Driver behavior; Driver license laws

3/11 Pedestrians

HS-010 916 Fld. 3/11

YOUNG CHILDREN IN TRAFFIC

by Stina Sandels

Published in *British Journal of Educational Psychology* v40 pt2 p111-6 (Jun 1970)

The Research Institute of Child Psychology at the University of Stockholm has been studying child traffic behavior since 1960. This article summarizes a book on their studies which was published, in Swedish, in 1968. Aspects studied were: spontaneous behavior of young children in traffic; knowledge of right and left; understanding of traffic; ability to perceive movements out of the corners of their eyes; ability to localize sounds; understanding of road signs; comprehension of traffic terms; effect of road safety teaching. Most of the studies

3/11 Pedestrians (Cont'd.)

HS-010 916 (Cont'd.)

dealt with pre-school age children; some included children to age 10.

Search terms: Child safety; Children; Child safety education; Behavior; Hazard perception; Motion perception; Visual perception; Auditory perception; Sign recognition; Judgment

4/0 OTHER SAFETY-RELATED AREAS

4/7 Mathematical Sciences

HS-010 917 Fld. 4/7; 5/6; 5/4

APPLICATION OF SIMILITUDE IN ENGINEERING ANALYSIS

by George Bovis

Deere and Co.

1971 17p 2 refs

Report no. SAE-710532

Presented at a meeting of the Mississippi Valley Section of the SAE, 21 Jan 1971.

This paper provides a detailed procedure for applying similitude (dimensional analysis) to engineering problems where there is not enough information for an analytical solution. Similitude allows the investigator to use experimental data to develop empirical prediction equations relating the parameters involved. Two examples illustrate the entire procedure. One is a four-pi-term problem and the other is an eight-pi-term. Both problems have exact analytical solutions, and the original data were computed analytically. This approach allows direct comparison of results obtained from the empirical equations with exact solutions. The procedure is illustrated in detail on three sample problems: development of power prediction equation for a two-cycle IC engine with respect to exhaust expansion chamber design; development of a prediction equation for the volume of diesel combustion chamber; and development of a prediction equation for belt length for a three-pulley system.

Search terms: Dimensional analysis; Design of experiments; Parameters; Mathematical analysis; Equations; Forecasting; Two stroke cycle engines; Exhaust systems; Combustion chamber design; Diesel engines; Belts

AVAILABILITY: SAE

HS-010 918 Fld. 4/7; 3/2

A THREE-DIMENSIONAL MATHEMATICAL MODEL TO PREDICT THE DYNAMIC RESPONSE OF AN AUTOMOBILE OCCUPANT

by Ronald D. Young

Texas A and M Univ. Texas Transp. Inst.

Published in *Highway Research Record* n344 p33-44 (1971)

13 refs

Sponsored by the Committee on Vehicle Characteristics and presented at the 50th annual meeting of the Highway Research Board.

The development of an analytical model that predicts the response of an automobile passenger in three-dimensional space during vehicle motion, which can also be three-dimensional in nature, is outlined. The predicted response includes position of the occupant relative to the vehicle, accelerations of various parts of the body, and forces acting on various parts of the body. Validation has been achieved with dummies for the case of frontal collisions in which the occupant is either totally unrestrained, restrained by a lap belt only, or restrained by a lap belt and a shoulder strap.

Search terms: Mathematical models; Computerized simulation; Restraint systems; Dummies; Secondary collisions; Equations of motion; Occupant modeling; Passenger compartments; Occupant kinetics

5/0 VEHICLE SAFETY

5/2 Buses, School Buses, and Multipurpose Passenger Vehicles

HS-010 919 Fld. 5/2

HOW SAFE IS A SCHOOL BUS?

Anonymous

Published in *Journal of American Insurance* v47 n4 p15-7 (Sep/Oct 1971)

The school bus safety record is relatively good but could be better. Some buses are ill-equipped, badly designed, or poorly driven, and safety experts credit the low fatality rate to motorists' care. Some states permit youths of 16 to drive buses, often overloaded and supervised only by the driver. Physicians for Automobile Safety recommends there be no standing, higher seats padded and with belts, and more flexible school snow days to reduce hazardous driving. Also recommended in the article: more insurance and safety precautions for school car pools.

Search terms: School bus safety; Car pools; Liability insurance; Accident risks; School bus drivers; Driver age; School bus design

5/4 Design

HS-010 920 Fld. 5/4

ENGINEERING AND STYLING OF THE 1972 CARS IMPROVE PRODUCT QUALITY AND RELIABILITY

by Robert E. Abbott

Published in *Product Engineering* v42 n14 p26-32 (Sep 1971)

Most domestic 1972 models offer only minor changes in styling and mechanical improvements as the automotive industry is preparing to meet the 1973 federal regulations on bumper design. Among features discussed are engines with lower emissions, carburetors, body-on-frame construction, rear suspension, brakes, steering, and better finishes.

Search terms: Automobile models; Automobile design; Automotive industry; Emission control; Quality control; Exhaust emission standards; Carburetors; Brake systems; Steering systems; Rear suspension systems; Reliability; Finishes; Engine design

HS-010 921 Fld. 5/4

LUBE OIL FILTRATION EFFECT ON DIESEL ENGINE WEAR

by J. L. Butler; J. P. Stewart; R. E. Teasley

Cummins Engine Co., Inc.

1971 11p

Report no. SAE-710813

Presented at the National Combined Fuels and Lubricants, Powerplant and Truck Meetings, St. Louis, 26-29 Oct 1971.

A series of comparative evaluation tests to determine the effect of various full-flow and combination full-flow and bypass filter systems on diesel engine piston ring and crankshaft bearings was made using radioactive tracer wear measurement and component weight loss techniques. The results of these tests indicate that bypass lube oil filtration combined with good full-flow lube oil filtration result in lowest engine wear rate and lowest total cost for the engine user.

Search terms: Lubricating oil tests; Oil filters; Diesel engines; Piston rings; Crankshafts; Engine wear; Particle size analysis; Radioactive tracers; Wear tests; Bearing tests; Test equipment; Laboratory tests; Engine operating conditions

AVAILABILITY: SAE

5/6 Fuel Systems

HS-010 922 Fld. 5/6

ENGINEERING KNOW-HOW IN ENGINE DESIGN—PT. 19

Society of Automotive Engineers, Inc.

1971 66p 108 refs

Report no. SAE-SP-365

Presented at the 17th of a series of annual lectures sponsored by SAE Milwaukee Section. Includes HS-010 923-7.

Five lectures cover the role of engine exhaust emissions in air pollution, measurement of emissions, pollutant formation and control, design factors affecting diesel emissions, and the effect of gasoline on automotive pollution.

Search terms: Vehicle air pollution; Exhaust emission control; Exhaust emission tests; Exhaust emissions measurement; Exhaust emission standards; Engine operating conditions; Diesel engine exhaust emissions; Air pollutants; Fuel composition; Air pollution control; Exhaust emission control devices; Air pollution emission factors

AVAILABILITY: SAE

HS-010 923 Fld. 5/6

THE ABCs OF ENGINE EXHAUST EMISSIONS

by P. S. Myers; O. A. Uyehara; H. K. Newhall

Wisconsin Univ.

Published in HS-010 922, *Engineering Know-How in Engine Design—Pt. 19* (SP-365), New York, 1971 p1-16

28 refs

Report no. SAE-710481

Presented at the 17th of a series of annual lectures sponsored by the SAE Milwaukee Section.

This paper indicates why certain exhaust constituents from automotive vehicles are considered pollutants, describes the formation of these pollutants in automotive operation, and details techniques

being used and considered to control these pollutants. The formation of pollutants—carbon monoxide, nitric oxide, hydrocarbons, particulates, and odor—in a variety of engine types and under a variety of conditions is described in detail. Vehicle emissions are also analyzed for real motor vehicle operation.

Search terms: Vehicle air pollution; Exhaust emission control; Carbon monoxide; Nitrogen oxides; Hydrocarbons; Particulate air pollutants; Odorants; Sulfur dioxide; Lead; Engine operating conditions; Air pollution emission factors

HS-010 924 Fld. 5/6

SOME INSTRUMENTATION AND TECHNIQUES FOR MEASURING ENGINE EMISSIONS

by Richard R. Booy

Outboard Marine Corp.

Published in HS-010 922, *Engineering Know-How in Engine Design—Pt. 19* (SP-365), New York, 1971 p17-23

15 refs

Report no. SAE-710482

Presented at the 17th of a series of annual lectures sponsored by the SAE Milwaukee Section.

The sources of engine/vehicle emissions are given, along with numerous devices for measuring the various types of emissions. A comprehensive explanation is made of the measuring devices more commonly used for engine exhaust emissions. Measurement techniques are discussed including sampling systems, instrument calibration, and test procedures. A modified chassis dynamometer arrangement and an experimental device for following a prescribed vehicle driving cycle are described.

Search terms: Vehicle air pollution; Exhaust emission control; Emission

5/6 Fuel Systems (Cont'd.)

HS-010 924 (Cont'd.)

standards; Evaporative emissions; Exhaust emission tests; Exhaust emissions measurement; Exhaust emissions sampling; Measuring instruments

HS-010 925 Fld. 5/6

MECHANISMS OF POLLUTANT FORMATION AND CONTROL FROM AUTOMOTIVE SOURCES

by Wayne M. Brehob

Ford Motor Co.

Published in HS-010 922, *Engineering Know-How in Engine Design—Pt. 19* (SP-365), New York, 1971 p24-39

20 refs

Report no. SAE-710483

Presented at the 17th of a series of annual lectures sponsored by the SAE Milwaukee Section.

There exists a reasonable sound theoretical understanding of the formation mechanisms for gaseous automotive emissions. It appears that a cleaned-up internal combustion engine, possible with extensive modifications such as heterogeneous combustion, will be the overall best automotive powerplant for at least the next decade. The paper discusses the sources of automotive pollution, causes of exhaust emissions, and methods of emission control.

Search terms: Vehicle air pollution; Exhaust emission control; Exhaust emission tests; Emission standards; Engine modification; Engine operating conditions; Catalytic converters; Thermal reactors; Internal combustion engines; Air pollution emission factors; Carbon monoxide; Nitrogen oxides; Hydrocarbons; Air fuel ratio; Exhaust emission control devices; Exhaust gas recirculation

HS-010 926 Fld. 5/6

DESIGN FACTORS THAT AFFECT DIESEL EMISSIONS

by Roger C. Bascom; Louis C. Broering; David E. Wulfhorst

Cummins Engine Co., Inc.

Published in HS-010 922, *Engineering Know-How in Engine Design—Pt. 19* (SP-365), New York, 1971 p40-54

39 refs

Report no. SAE-710484

Presented at the 17th of a series of annual lectures sponsored by the SAE Milwaukee Section.

Although diesels, as a group, are a relatively small source of air pollutants, emissions standards which limit emissions from diesels have been adopted by California and the Federal government. Test procedures and instrumentation for measuring diesel emissions have been developed, and an understanding of how engine design parameters affect emissions is evolving. Smoke suppressant additives, water induction, exhaust gas recirculation, and catalytic converters reduce one or more of the emissions but are less desirable than emissions control through engine modifications.

Search terms: Diesel engine exhaust emissions; Smoke; Measuring instruments; Vehicle air pollution; Exhaust emission control; Exhaust emission tests; Engine operating conditions; Exhaust emission standards; Engine modification; Catalytic converters; Engine design; Air fuel ratio; Nitrogen oxides; Hydrocarbons; Carbon monoxide; Exhaust gas recirculation

HS-010 927 Fld. 5/6

MOTOR GASOLINE AND AUTOMOTIVE AIR POLLUTION

by T. O. Wagner

American Oil Co.

Published in HS-010 922, *Engineering Know-How in Engine Design—Pt. 19* (SP-365), New York, 1971 p55-62

6 refs

Report no. SAE-710485

Presented at the 17th lecture of a series of annual lectures planned by the Milwaukee Section of the SAE.

Until 1970, emission standards and car modifications needed to comply with state regulations had relatively little effect on gasoline quality. Then in 1970, Ford and GMC announced that all or nearly all their 1970 and later model cars would be designed to operate on unleaded gasoline of 91 research octane number. This paper covers the production capabilities of the petroleum industry, the effect of leaded gasoline on emissions, consumer advantages and disadvantages of unleaded gasoline, gasoline volatility, and future gasoline quality.

Search terms: Vehicle air pollution; Gasoline refining; Petroleum industry; Gasoline quality; Gasoline volatility; Lead free gasoline; Leaded gasoline; Fuel composition; Fuel additives; Exhaust valve wear; Exhaust emission tests; Octane requirements; Hydrocarbons; Air pollution emission factors

HS-010 928 Fld. 5/6

INTER-INDUSTRY EMISSION CONTROL (IIEC). A CO-OPERATIVE RESEARCH PROGRAM FOR AUTOMOTIVE EMISSION CONTROL

Society of Automotive Engineers, Inc.

1971 224p 101 refs

Report no. SAE-SP-361

Includes HS-010 929 — 010 934; 010 940 — HS-010 941

This three year research program on automotive emission control was formed

in 1967 by Ford Motor Company and Mobil Oil Corporation. Five other oil companies joined and the program became international with the inclusion of one Italian and three Japanese automobile manufacturers. The program's emission control goals were nil crankcase and evaporative losses and exhaust levels of 0.82 gm/mi (65ppm) for HC, 7.1 gm/mi (0.3 mole%) for CO, and 0.68 gm/mi (175 ppm) for NO_x. Basic approaches were changes in engine components, fuels, and lubricants; disposable catalytic converters—perhaps with lead traps—for use with leaded fuels; catalytic converters for low-lead or unleaded gasoline; and high efficiency thermal reactors. After laboratory studies and road tests, several low-emission vehicle systems met program objectives. Extensive durability testing and development will be needed to ensure effectiveness for the life of the vehicle.

Search terms: Crankcase emissions; Evaporative emissions; Exhaust emissions; Exhaust emission control; Exhaust emission control devices; Road tests; Carbon monoxide; Hydrocarbons; Nitrogen oxides; Fuel additives; Inter Industry Emission Control Program; Lubricant additives; Engine modification; Catalytic converters; Thermal reactors; Petroleum industry; Laboratory tests; Leaded gasoline; Lead free gasoline; Emission standards; International factors; Automotive industry

AVAILABILITY: SAE

HS-010 929 Fld. 5/6

NO_x REDUCTION CATALYSTS FOR VEHICLE EMISSION CONTROL

by G. H. Meguerian; C. R. Lang

American Oil Co.; Ford Motor Co.

Published in HS-010 928, *Inter-Industry Emission Control* (SP-361), New York, 1971

22p 13 refs
Report no. SAE-710291

Presented at Automotive Engineering Congress, Detroit, 11-15 Jan 1971.

The objective of this project was to develop and evaluate a catalyst system for control of oxides of nitrogen in order to achieve target reduction levels established for the Inter-Industry Emission Control Program, with concurrent control of the hydrocarbons and carbon monoxide. The major effort described is the exploration of catalysts and the development of a suitable exhaust gas-temperature environment. The objective was met, with the exception of long-term durability, by using a pelleted, non-noble metal catalyst and a special container design.

Search terms: Nitrogen oxides; Catalysts; Inter Industry Emission Control Program; Hydrocarbons; Carbon monoxide; Exhaust emission control devices; Exhaust emission standards; Exhaust gases; Exhaust emissions reactivity; Catalytic converters; Laboratory tests; Test equipment; Materials tests; Dual bed catalyst systems; Air fuel ratio; Durability tests; Metals; Temperature

HS-010 930 Fld. 5/6

CATALYTIC CONVERTER VEHICLE SYSTEM PERFORMANCE: RAPID VERSUS CUSTOMER MILEAGE

by E. E. Hancock; R. M. Campau; R. Connolly

Ford Motor Co.

Published in HS-010 928, *Inter-Industry Emission Control* (SP-361), New York, 1971

28p 6 refs
Report no. SAE-710292

Presented at Automotive Engineering Congress, Detroit, 11-15 Jan 1971.

Two types of catalysts were tested in a fleet of 24 vehicles operated in urban driving conditions on both leaded and unleaded fuels over a 1½ year period. The two catalyst types and the converter systems chosen for this evaluation were selected on the basis of information obtained from an earlier test program involving four cars durability tested on a more rapid test track mileage accumulation cycle. Comparisons are made between the vehicles running rapid mileage accumulation and the vehicles running slower customer-type mileage accumulation. Results show that catalyst life and system performance depreciation were relatively similar in both fleets and did not seem to be significantly affected by the method of mileage accumulation. The 24 vehicles were equipped with a programmed protection system designed to protect the catalysts from damage due to over-temperature operation. Problems with this protection system are discussed.

Search terms: Catalysts; Vehicle mileage; Leaded gasoline; Lead free gasoline; Catalytic converters; Durability tests; Performance tests; Urban traffic flow; Instrumented vehicles; Exhaust emissions measurement; Inter Industry Emission Control Program; Driving conditions

HS-010 931 Fld. 5/6

THERMAL REACTOR—DESIGN, DEVELOPMENT AND PERFORMANCE

by A. Jaimee; D. E. Schneider; A. I. Rozmanith; J. W. Sjoberg

Ford Motor Co.; Mobil Res. and Devel. Corp.

Published in HS-010 928, *Inter-Industry Emission Control* (SP-361), New York, 1971

36p 20 refs
Report no. SAE-710293

Presented at Automotive Engineering Congress, Detroit, 11-15 Jan 1971.

5/6 Fuel Systems (Cont'd.)

HS-010 931 (Cont'd.)

Thermal reactor systems have been designed to develop a low emission vehicle to meet exhaust emission goals established by the Inter-Industry Emission Control Program, for hydrocarbons, carbon monoxide, and nitrogen oxides. The reactor included design features required for acceptable life characteristics, together with the quick warm-up necessary to achieve the emission targets. Exhaust gas recirculation and enriched carburetion are used to reduce the oxides of nitrogen. Associated problems defined during development of several thermal reactor systems are described. The primary problem was achieving durability at the typically high operating exhaust gas temperatures necessary for concurrent emission control. Fuel additives such as lead, halogen scavengers, phosphorus, and sulfur were studied extensively under thermal cycling engine operating conditions to determine their effects on material durability. Corrosion control of reactor materials will require unleaded or low leaded fuel.

Search terms: Engine operating conditions; Thermal reactors; Exhaust emission standards; Hydrocarbons; Carbon monoxide; Nitrogen oxides; Inter Industry Emission Control Program; Exhaust gas recirculation; Carburetors; Fuel additives; Thermal kinetics; Durability tests; Rich fuel mixtures; Leaded gasoline; Lead free gasoline; Materials tests; Lead; Halogens; Exhaust gases; Exhaust manifold reactors; Fuel economy; Coldstarts; Test equipment; Corrosion tests; Phosphorus; Sulfur

HS-010 932 Fld. 5/6

LOW EMISSION CONCEPT VEHICLES

by R. M. Campau

Ford Motor Co.

Published in HS-010 928, *Inter-Industry Emission Control* (SP-361), New York, 1971

35p 26 refs
Report no. SAE-710294

Presented at Automotive Engineering Congress, Detroit, 11-15 Jan 1971.

A joint automotive and petroleum research program to develop prototype fuel and hardware requirements for low emission vehicle systems is described. The relevance of the very stringent emission targets established by the Inter-Industry Emission Control Program on the overall improvement in ambient air quality for the Los Angeles Basin is illustrated. Three systems are described and their emission data given. Preliminary data are presented from a fourth system which combines the emission hardware features of the three earlier systems, thermal reactors with catalysts and an exhaust gas recirculation system. Vehicle fuel economy penalties and operating temperature problems of the low emission concept vehicles are discussed. A projection is made on how the emission levels achieved in these single vehicle tests would increase to account for the depreciation of the emission control system with mileage and for tolerances and variability existing in mass production.

Search terms: Exhaust emission control devices; Exhaust emission standards; Inter Industry Emission Control Program; Los Angeles; Thermal reactors; Catalysts; Exhaust gas recirculation; Fuel economy; Forecasting; Vehicle mileage; Nitrogen oxides; Air quality standards; Air fuel ratio; Torque; Engine operating conditions; Ignition timing; Coldstarts; Durability tests; Fuel composition; Lead free gasoline; Carbon monoxide; Catalytic converters; Dual bed catalyst systems

HS-010 933 Fld. 5/6

EFFECT OF FUEL AND LUBRICANT ADDITIVES ON EXHAUST EMISSIONS

by L. M. Mixon; A. I. Rozmanith; W. T. Wotring

American Oil Co.; Mobil Res. and Devel. Corp.; Standard Oil Co. (Ohio)

Published in HS-010 928, *Inter-Industry Emission Control* (SP-361), New York, 1971

24p 4 refs
Report no. SAE-710295

Presented at Automotive Engineering Congress, Detroit, 11-15 Jan 1971.

The effect of additives on exhaust emissions was studied when additives were in engine oil, in gasoline, and injected directly into the exhaust gas. Substantial reduction of hydrocarbon and carbon monoxide emissions was obtained only when peroxides were injected in the presence of secondary air into the exhaust gas at the exhaust port. Fuel additives were evaluated for favorably modifying combustion kinetics, and for reducing hydrocarbon emissions related to combustion chamber deposits and quench volume. No substantial effects were found. Engine oil additive type and concentration also had no substantial effect on hydrocarbon emissions caused by combustion chamber deposits.

Search terms: Fuel additives; Lubricant additives; Hydrocarbons; Carbon monoxide; Peroxides; Combustion chamber deposits; Exhaust gas additives; Exhaust emission standards; Inter Industry Emission Control Program; Thermal kinetics; Combustion rate; Quenching; Exhaust ports; Air injection; Exhaust gases; Single cylinder engines; Vehicle mileage; Coldstarts; Lead free gasoline; Leaded gasoline; Exhaust emission tests; Ash content; Exhaust emissions sampling

HS-010 934 Fld. 5/6

SMALL ENGINE - CONCEPT EMISSION VEHICLES

by Yasuo Kaneko; Hiroshi Kuroda;
Kazuyudi Tanaka

Mitsubishi Motors Corp. (Japan); Nissan
Motor Co. Ltd. (Japan); Toyo Kogyo
Co. Ltd. (Japan)

Published in HS-010 928, *Inter-Industry
Emission Control*, (SP-361), New York,
1971

19p 5 refs

Report no. SAE-710296

Presented at Automotive Engineering
Congress, Detroit, 11-15 Jan 1971.

Three Japanese auto manufacturers have been making efforts for three years to design and develop effective thermal reactor-exhaust gas recirculation and catalytic converter systems suitable for small size engines. The members are participating in the Inter-Industry Emission Control Program. As a result, the exhaust emission levels of the concept vehicles developed by these companies have met the goal established by the program at low mileage. Much investigation is required, particularly with respect to durability, before completion of any system that will fully satisfy all service requirements. This paper reports the progress of research and development of the individual concept vehicles.

Search terms: Thermal reactors;
Catalytic converters; Exhaust gas re-
circulation; Exhaust emission control
devices; Inter Industry Emission
Control Program; Vehicle mileage;
Durability tests; Exhaust emission
standards; Japanese vehicles; Engine
size; Hydrocarbons; Carbon monoxide;
Nitrogen oxides; Air fuel ratio; Ex-
haust ports; Engine modification;
Temperature; Performance tests; Cold-
starts; Dual bed catalyst systems

HS-010 935 Fld. 5/6

EFFICIENT SYSTEM DESIGN AND THE USE OF ELECTRONIC INSTRUMENTATION TO FIND AND CORRECT INEFFICIENT AREAS

by W. T. Stephens

Gresen Mfg. Co.

1971 7p

Report no. SAE-710738

Presented at a meeting of the SAE
Mississippi Valley Section, 29 Apr
1971.

Inefficiencies in an hydraulic system become the heat problem of the system. The easy way to solve the heat problem is to add a heat transfer unit. This cools the oil after the fact. The localized heat at its sources continues to cause breakdown of the oil and excessive wear on parts, seals, etc. In most mobile systems the heat can be reduced to a livable level without the use of coolers. Where a cooler must be used the cooler can be smaller, or the oil temperature lower, by making the system as efficient as practical. Electronic instrumentation can point up areas of heat buildup in the system and show the results of corrective measures. Instrumentation can also assist in reducing the vehicle horsepower requirement by the proper use of available power.

Search terms: Hydraulic equipment;
Electronic monitoring systems; Heat
transfer; Engine operating conditions;
Oil pressure; Operating pressure; Oil
pumps

AVAILABILITY: SAE

HS-010 936 Fld. 5/6

THE EFFECT OF LEADED AND UNLEADED GASOLINES ON EXHAUST EMISSIONS AS INFLUENCED BY COMBUSTION CHAMBER DEPOSITS. (CRC PROJECT CAPE-3-68)

by Henry E. Leikkanen; E. W. Beckman

Texaco, Inc.; Chrysler Corp.

1971 29p 7 refs

Report no. SAE-710843

Presented at the National Combined
Fuels and Lubricants, Powerplant and
Truck Meetings, St. Louis, 26-29 Oct
1971.

To assess how lead antiknock compounds in gasolines influence combustion chamber deposits and exhaust emission levels, an intensive state-of-the-art review has been made, and data submitted by 18 different companies have been analyzed. These studies ranged in scope from single-cylinder engine investigations to a 122-car consumer test program. Based on this review, it was concluded that cars operated on leaded gasolines have higher equilibrium hydrocarbon emissions than those operated on unleaded gasolines, and that mileage accumulation conditions exert a major influence on the magnitude of the hydrocarbon net lead effect. The presence of lead in gasoline has no effect on carbon monoxide emission levels.

Search terms: Leaded gasoline; Lead
free gasoline; Hydrocarbons; Carbon
monoxide; Nitrogen oxides; Com-
bustion chamber deposits; Exhaust
emission tests; Exhaust emissions
measurement; Engine operating condi-
tions; Fuel additives; Vehicle mileage;
Laboratory tests; Engine tests

AVAILABILITY: SAE

HS-010 937 Fld. 5/6

EFFECT OF COMPRESSION RATIO, MIXTURE STRENGTH, SPARK TIMING, AND COOLANT TEMPERATURE UPON EXHAUST EMISSIONS AND POWER

by R. C. Lee

Phillips Petroleum Co.

5/6 Fuel Systems (Cont'd.)

HS-010 937 (Cont'd.)

1971 18p 11 refs
Report no. SAE-710832

Presented at the National Combined Fuels and Lubricants, Powerplant and Truck Meetings, St. Louis, 26-29 Oct 1971.

A single-cylinder engine operating at constant speed using gasoline as fuel was used to study the effects of compression ratio, mixture strength, spark timing, and coolant temperature upon exhaust emissions and power for a part-throttle condition. Of these variables, mixture strength and spark timing had the largest effect upon exhaust emissions, followed by coolant temperature with compression ratio having minor effects. Spark timing followed by compression ratio had the largest effect upon power and fuel consumption.

Search terms: Engine operating conditions; Stoichiometry; Exhaust emission tests; Nitric oxide; Carbon monoxide; Hydrocarbons; Compression ratio; Fuel mixtures; Spark timing; Mathematical models; Mathematical analysis; Confidence intervals; Regression analysis; Coolant temperature; Engine speeds; Single cylinder engines

AVAILABILITY: SAE

HS-010 938 Fld. 5/6

EFFECT OF ENGINE INTAKE-AIR HUMIDITY, TEMPERATURE, AND PRESSURE ON EXHAUST EMISSIONS

by S. R. Krause
Ethyl Corp.

1971 40p 8 refs
Report no. SAE-710835

Prepared for presentation at the National Combined Fuels and Lubricants, Powerplant, and Truck Meetings, St. Louis, 26-29 Oct 1971.

Variations in atmospheric humidity, temperature, and barometric pressure substantially affect exhaust emissions. Emission measurements were conducted on seven engines in accordance with the gasoline fueled heavy-duty engine procedures in the 1970 Federal Register. Equations were derived to correct NO, HC, and CO emissions for certain variations, although not for all conditions for all seven engines. Emissions from different engines are affected differently at various atmospheric conditions. Therefore, accurate emission testing on some engines can only be accomplished by controlling inlet air temperature and by testing on days of similar barometric pressure.

Search terms: Engine operating conditions; Exhaust emissions measurement; Exhaust emission standards; Environmental factors; Nitrogen oxides; Carbon monoxide; Hydrocarbons; Air fuel ratio; Equations; Humidity; Ambient temperature effect on exhaust; Air pressure; Exhaust emission tests; Mathematical models; Intake systems

AVAILABILITY: SAE

HS-010 939 Fld. 5/6

EFFECTS OF GASOLINE ADDITIVES ON CARBURETOR AND PCV SYSTEM PERFORMANCE AS THEY RELATE TO EXHAUST EMISSIONS. FIRST YEAR REPORT

Scott Res. Labs., Inc.

1970 88p
Report no. APTD-0591; PB-195 143

Three groups of 16 cars each, or a total of 48 fleet vehicles, are being driven in normal urban and suburban modes of

operation over a 24,000 mile interval under controlled fuel conditions and maintenance. Each group of 16 cars is being operated on the same fuel base. Two of the three groups' test fuels contain a gasoline additive. Exhaust emission measurements were made as the vehicles started the test and at each subsequent 4,000 mile interval. An analysis of variance was conducted on each of the 19 emission parameters for the zero and 4,000 mile interval. No significant differences in emission parameters were determined at the 4,000 mile point on the basis of fuel employed. All emissions parameters vary significantly between makes; however, no single make is consistently the highest or lowest valued across the spectrum of the 19 emission parameters measured.

Search terms: Vehicle air pollution; Exhaust emissions; Fuel additives; Positive crankcase ventilation valves; Engine operating conditions; Vehicle maintenance; Carburetors; Exhaust composition; Road tests; Automobile models; Exhaust emission tests; Variance analysis; Engine speeds

AVAILABILITY: NTIS as PB-195 143

HS-010 940 Fld. 5/6; 4/7

MATHEMATICAL MODELING OF CO AND HC CATALYTIC CONVERTER SYSTEMS

by J. C. W. Kuo; C. R. Morgan; H. G. Lassen

Mobil Res. and Devel. Corp.; Ford Motor Co.

Published in HS-010 928, *Inter-Industry Emission Control*, (SP-361), New York, 1971

48p 18 refs
Report no. SAE-710289

Presented at Automotive Engineering Congress, Detroit, 11-15 Jan 1971.

A mathematical model to predict the performance of catalytic converter systems that reduce the hydrocarbon and carbon monoxide contents in automobile exhaust gas is described. This model contains all the important system parameters and process variables and it predicts the performance of real vehicle-converter systems well. The application of this model includes the converter inlet data analysis, parametric analysis, converter design study, and catalyst design study.

Search terms: Mathematical models; Hydrocarbons; Carbon monoxide; Catalytic converters; Catalysts; Performance characteristics; Forecasting; Inter Industry Emission Control Program; Exhaust emission control devices; Parameters; Variables; Oxidation; Exhaust gases; Exhaust emissions reactivity; Thermal kinetics

of these catalysts has been aided by a mathematical model of the catalytic converter and by unique experimental techniques. Laboratory tests were complemented by vehicle durability evaluations which indicated that after mileage accumulation catalyst loss took place. Improved converter designs and more attrition resistant catalysts have improved system durability. Lab tests predict that some catalysts will meet goals for more than 12,000 miles with leaded fuel, and a larger number will meet goals for 50,000 miles with low leaded or unleaded fuel.

Search terms: Inter Industry Emission Control Program; Exhaust emission standards; Hydrocarbons; Carbon monoxide; Nitrogen oxides; Catalytic converters; Laboratory tests; Vehicle mileage; Catalysts; Leaded gasoline; Lead free gasoline; Oxidation; Mathematical models; Durability tests; Road tests; Exhaust emission control devices; Test equipment

HS-010 941 Fld. 5/6; 4/7

HC/CO OXIDATION CATALYSTS FOR VEHICLE EXHAUST EMISSION CONTROL

by K. I. Jagel; F. G. Dwyer

Mobil Res. and Devel. Corp.

Published in HS-010 928, *Inter-Industry Emission Control* (SP-361), New York, 1971

18p 9 refs
Report no. SAE-710290

Presented at Automotive Engineering Congress, Detroit, 11-15 Jan 1971.

Hydrocarbon and carbon monoxide oxidation catalysts having good catalytic activity, stability, and improved physical durability were developed. Based on laboratory tests, these catalysts should meet the Inter-Industry Emission Control Program HC and CO emission levels and the durability goals in vehicles in which HC, CO, and NO_x goals are achieved simultaneously. Development

vehicles are outlined, followed by a detailed discussion of the exhaust emission standards and CACR test procedures. The report also includes a discussion of the automotive fuels used in the race and actual costs of the race. The winner used a modified V-8 engine with catalytic reactors, burning special unleaded gasoline.

Search terms: Vehicle air pollution; Air pollution control; Air quality standards; Exhaust emission control; Exhaust emission control devices; Air pollution effect on health; Exhaust emission tests; Exhaust emissions measurement; Fuels; Financing; Vehicle characteristics; Experimental automobiles; Electric automobiles; Hybrid automobiles; Racing; Air pollution emission factors; Catalytic converters; History; Automobile performance; Performance tests; Exhaust emission standards

AVAILABILITY: NTIS as PB-199 479

HS-010 942 Fld. 5/6; 5/15; 2/7

CLEAN AIR CAR RACE-1970. A SUMMARY REPORT

Massachusetts Inst. of Tech.

1971 300p
Contract CPA-70-169
Report no. APTD-0680; PB-199 479

A summary report of the 1970 Clean Air Car Race (CACR) is presented. Briefly discussed are sources and health effects of air pollution and current control procedures for internal-combustion engine exhaust. A synopsis of events leading to the CACR, and a summary of achievements and impacts of the race are presented. The report includes discussion of the winners of the CACR; the classification of their vehicle power plants, selection procedure for the winners, and other pertinent facts about the class winners and the overall winner. The performance test procedures for CACR

5/11 Maintenance and Repairs

HS-010 943 Fld. 5/11; 5/18

SERVICING COLLAPSIBLE COLUMNS

Anonymous

Published in *Motor Age* v90 n9 p79-82 (Sep 1971)

The steering column is a complex safety system and requires careful servicing to maintain its safety and operating features. Steps are outlined for disassembling and servicing the steering column and its component parts.

Search terms: Repairing; Vehicle maintenance; Energy absorbing steering columns; Steering inspection; Mechanics (personnel); Steering systems

5/14 Occupant Protection

HS-010 944 Fld. 5/14

WHAT EVERY YOUNG MOTHER SHOULD KNOW ABOUT AUTO SAFETY

by Edward D. Fales, Jr.

Published in *Redbook* v135 n5 p91, 193-7 (Sep 1970)

One of the first things a driving mother should do is learn the truth about a number of myths: that she can protect her child when she sees an accident coming, that most serious accidents are head-on collisions between two cars, that a car is a protective cage that can be counted on to ward off danger in a minor collision. The only protection for children (and their mothers) is a proper restraint system. Safe and unsafe child restraint systems are considered, and some safe driving tips are proposed. The part played by stress in driving with children is discussed.

Search terms: Child restraint systems; Infant restraint systems; Child safety seats; Child seat belts; Child safety; Female drivers; Driver performance under stress

HS-010 945 Fld. 5/14; 5/20

DEVELOPMENT OF ROPS CRITERIA FOR CONSTRUCTION AND INDUSTRIAL VEHICLES

by J. E. Staab

Caterpillar Tractor Co.

1971 14p 14 refs
Report no. SAE-710693

Presented at the National Farm, Construction and Industrial Machinery meeting, Milwaukee, 13-16 Sep 1971.

Performance standards for roll-over protective structures (ROPS) have been developed for four classes of equip-

ment-tracked tractors, loaders, motor graders, and wheel scraper prime movers. The criteria were developed, after study of European, Federal, and California codes, by studying the behavior of roll-proven structures in a laboratory and converting these observations into numerical relationships. The criteria establish five major requirements: resist horizontal force (related to machine weight); absorb energy (must deflect without catastrophic failure); withstand vertical load after deflection equal to machine weight; meet above requirements without entering critical zone; must perform at 0°F or material must exhibit Charpy "v" notch impact strength of 8 ft-lb at -20°F.

Search terms: Construction vehicles; Off the road vehicles; Heavy duty vehicles; Rollover tests; Vehicle stability; Static tests; Rollover protective structures; Occupant protection; Performance characteristics; Laboratory tests; Impact tolerances; Design standards; Vehicle weight

AVAILABILITY: SAE

HS-010 946 Fld. 5/14; 5/20

CALIFORNIA'S DEVELOPMENT OF SAFETY STANDARDS FOR HEAVY EARTHMOVING EQUIPMENT

by Clifford W. Farmer

California Dept. of Industrial Relations

1971 4p
Report no. SAE-710695

Presented at the National Farm, Construction and Industrial Machinery Meeting, Milwaukee, 13-16 Sep 1971.

California established the Division of Industrial Safety to develop and enforce safety standards for the workmen in places of employment. Many safety standards have been developed which included roll-over protective structures for heavy earthmoving equipment. When

it is determined that a need exists for a new safety order such as Construction Safety Order 1596, which requires roll-over protective structures for heavy earthmoving equipment, the division thoroughly analyzes the engineering, education, and enforcement procedures and techniques as they develop the state safety standard. At the present time, the division is investigating the need for safety standards pertaining to environmental control for the operators of equipment used in construction.

Search terms: Construction vehicles; Safety standards; California; Industrial safety; Rollover protective structures; State action

AVAILABILITY: SAE

5/15 Propulsion Systems

HS-010 947 Fld. 5/15; 5/6

IS CLEANLINESS THREE-CORNERED?

by Anthony Curtis

Published in *New Scientist and Science Journal* v49 n740 p415-7 (25 Feb 1971)

The advantages and disadvantages of the Wankel rotary engine are described. It is a possible replacement for the piston engine. The Wankel engine's exhaust has a low level of oxides of nitrogen and can be used with a thermal reactor which helps remove unburned hydrocarbons. There has been a problem of apex seal wear which new materials should overcome.

Search terms: Exhaust emission standards; Wankel engines; Thermal reactors; Hydrocarbons; Nitrogen oxides; Rotary engines; Apex seals

HS-010 949 Fld. 5/15; 5/12

THE ECONOMIC IMPACT OF CONVERSION TO A NON-POLLUTING AUTOMOBILE

by Edward Ayres

International Res. and Technology Corp.

1969 96p 40 refs

Contract PS-01040

Report no. IRT-R-12; PB-199 925

The impact of a changeover in the production of American automotive power plants from the conventional internal combustion engine to a non-polluting engine would be felt in nearly every sector of the economy. For a few industries—automotive wholesale and retail trade, automotive repairs and service, engine electrical equipment, petroleum refining, nonferrous metals, and several others—the impact would be large. The demand for copper, aluminum, stainless steel, and cast iron would probably increase, while the demand for steel would decrease. The greatest impact would be on the auto manufacturing industry itself, which is characterized by a high degree of vertical integration. A gradual changeover not only would permit amortization of initial costs; it would also enable the auto and tool-and-die manufacturers to coordinate capital expenditures with needed replacements and modernizations. State-by-state lists are given of industries affected.

Search terms: Vehicle air pollution; Economic analysis; Automotive industry; Automotive parts industry; Repair industry; Petroleum industry; Automobile manufacturing; Automobile materials; External combustion engines; Internal combustion engines; Economic factors; Forecasting

AVAILABILITY: NTIS as PB-199 925

5/18 Steering Control System

HS-010 950 Fld. 5/18; 5/1

TAKING THE DIVE OUT OF BRAKING

by S. A. V. Swanson

Published in *Autocar* v135 n3934 p4-7 (19 Aug 1971)

The origins of the problem of "nose-dive" under braking are discussed. The problem is related to load transfer and center of gravity. Methods of compensating for dive are discussed for different types of suspensions and brake locations, and the variety of approaches in use on European cars is described.

Search terms: Leveling devices; Suspension systems; Braking forces; Pitch; European vehicles; Vehicle center of gravity; Load transfer; Brake systems; Suspension systems

5/20 Trucks and Trailers

HS-010 951 Fld. 5/20

THE SAFETY AND OPERATING CHARACTERISTICS OF BIG TRUCKS

by T. D. Sherard

Western Hwy. Inst.

1971 8p 10 refs

Report no. SAE-710632

Presented at the SAE Northwest Section meeting, 13 Apr 1971.

Large highway trucks have a better accident record than most other vehicles. Yet proposed Federal standards require safety performance which is barely possible in new trucks and which would result in exorbitant costs for vehicles in use, especially multiple units. Trucking opponents have distorted the significance of increased size and weight limits; 102-inch-wide vehicles can be operated safely and successfully, vehicle lengths of multiple combinations would be less than 100 feet, and weights less than 100,000 pounds. Tests show better braking and stability for three-unit combinations, and big truck tires almost never hydroplane. Skilled drivers and good maintenance contribute to truck safety.

Search terms: Truck accidents; Truck brakes; Truck safety standards; Truck stability; Truck driver performance; Vehicle size limits; Vehicle weight

limits; Truck maintenance; Truck performance; Accident rates; Articulated vehicles; Multitrailers; Passing

AVAILABILITY: SAE

HS-010 952 Fld. 5/20

THE ALLISON AT-540 AUTOMATIC TRANSMISSION IN UTILITY TRUCK APPLICATIONS

by A. R. Schuette

General Motors Corp.

1971 12p

Report no. SAE-710658

Presented at the National Combined Fuels and Lubricants, Powerplant and Transportation Meetings, St. Louis, 25-29 Oct 1971.

September 1970 marked the introduction of the first automatic transmission designed specifically for single-drive axle trucks and buses in the 10,000 to 36,000 pound GVW class. This new product is designated the AT-540 four speed, fully automatic transmissions. After the background on the development of the AT-540 is presented, the basic design features and general applications are defined. The considerations of the vocations in which it will be applied are then discussed as related specifically to utility trucks. This includes power takeoff requirements, vehicle performance, and installation. Verification of the compatibility of the AT-540 transmission is presented with specific reference to the test program conducted, vehicle operation, and production testing. The AT-540 has proven itself to be a durable, worthwhile component of vehicles for the utility industry.

Search terms: Automatic Transmission; Truck design; Truck performance; Power takeoff equipment; Drive gears; Performance tests; Utilities; Transmission tests; Axle loads; Vehicle weight; Durability tests; Road tests; Fatigue tests

AVAILABILITY: SAE

5/22 Wheel Systems**HS-010 953** Fld. 5/22; 4/7**RECENT ADVANCES IN KNOWLEDGE OF RUBBER FRICTION AND TIRE WEAR**

by A. Schallamach

Published in *Rubber Chemistry and Technology* v41 n1 p209-44(Feb 1968)

43 refs

Wear of tires and abrasion on certain laboratory machines brings into play gross properties of the tire or testpiece which affect rate of wear just as much as the actual abrasion resistance of the tread compound. This new field of research has led to rationalization of road testing, and has helped to bridge the gap between laboratory and road. Much laboratory work is concerned with the viscoelastic nature of rubber friction and abrasion, which has come to light through the experimentally established validity of the rate-temperature equivalence principle. Experiments on friction, theories of friction, and abrasion mechanisms are described.

Search terms: Tire traction; Tire wear; Tire temperature; Rubber; Road tests; Laboratory tests; Mathematical models; Friction studies; Abrasion tests; Viscoelasticity; Tire treads; Tire tests; Tire forces; Tire properties; Tire slip motion

NHTSA DOCUMENTS**NHTSA Contractors Reports****HS-800 575** Fld. 5/0**DATA REQUIREMENTS FOR EVALUATION OF MOTOR VEHICLE SAFETY STANDARDS. FINAL REPORT**

by H. C. Jokschi; H. Wuerdemann

Center for Environment and Man, Inc.

1971 131p 24 refs

Contract DOT-HS-033-1-038

Report for Jan-Sep 1971.

A methodology for evaluating the effects of motor vehicle safety standards is developed. Measures for effectiveness and mathematical models are described. Functions of the standards are reviewed, accident categories in which they become effective are identified, and information required to describe these categories is determined. Interactions among the standards are described and sources of data for standards evaluation reviewed. Combined information appears adequate to evaluate crash phase and postcrash standards but inadequate for precrash standards. Ways to acquire presently unavailable information are discussed. Based on Virginia data, it is estimated that injury risk in 1967 model cars is reduced by 10-15% against older cars, and in 1968-1970 model cars is reduced by 25%. Estimates for potential effects of some standards are given.

Search terms: Vehicle safety standards; Safety device effectiveness; Mathematical models; Crash phase; Postcrash phase; Precrash phase; Data acquisition; Injuries by vehicle age; Injury probability; Injury rates; Virginia; Injury prevention; Occupant protection; Accident studies; Injury severity; Accident types; Program evaluation

AVAILABILITY: NTIS**NHTSA Staff Speeches, Papers, .****HS-810 193** Fld. 5/22**NONDESTRUCTIVE TIRE TESTING STUDIES**

Department of Transp., Transp. Systems Center

1972 31p

The purposes of this investigation were: to determine the types of tire defects that can be reliably and economically detected by nondestructive methods and to determine the relationship between tire defects and failure. The test methods used were X

ray, holography, infrared, and ultrasonics. New and retreaded tires were investigated and defects recorded. The tires were exercised by endurance and high speed tests and then reexamined. Computerized data analysis was employed. It is hoped that the program can lead to further development of nondestructive devices for tire study and that the statistical treatment of the data will eventually provide a method for accurately predicting tire failure.

Search terms: Nondestructive tests; Tire test; Tire failures; Tire test equipment; Tire defects; X ray analysis; Holography; Infrared analyzers; Ultrasonic tests; Statistical analysis; Data processing; High speed; Durability tests; Forecasting

AVAILABILITY: NTIS**NHTSA Imprints****HS-820 181** Fld. 5/4**INTERNATIONAL TECHNICAL CONFERENCE ON EXPERIMENTAL SAFETY VEHICLES (2ND) SINDELFINGEN, GERMANY, OCTOBER 26-29, 1971. REPORT**

National Hwy. Traf. Safety Administration

1971 1v refs

The nature and status of experimental safety vehicle programs in their countries were described by governmental representatives from the United States, Germany, Japan, Great Britain, Italy, France, the Netherlands, Sweden, and Belgium. Technical presentations were made by representatives of the automotive industries of six countries dealing with experimental safety vehicles, crashworthiness, vehicle safety, and safety devices. A crashworthiness seminar considered problems of structure in safety cars, restraints, occupant simulation, subsystems, and testing. An accident avoidance seminar

considered problems of visibility, vehicle steering and handling, accident contributing factors, application of radar to auto control and sensing, and braking.

Search terms: Conferences; Experimental vehicles; Safety cars; Crashworthiness; Safety design; Automobile design; Restraint systems; International factors; Federal role; United States; Germany; Occupant protection; Impact tests; Accident avoidance; Safety research; Test equipment; Japan; Great Britain; Italy; France; Netherlands; Sweden; Belgium; Vehicle handling; Vehicle control; Automobile safety characteristics; Safety devices; Crashworthy bodies; Automotive industry; Vehicle safety; Human body simulation; Radar; Sensors; Accident factors; Steering; Visibility; Braking

HS-820 200 Fld. 5/14

DEVELOPMENT OF ANTICIPATORY AUTOMOBILE CRASH SENSORS. ANNUAL REPORT

by John B. Hopkins; F. Ross; Holmstrom; Edward G. Apgar; Morrin E. Hazel; A. Timothy Newfell; Edward F. White

Department of Transp., Transp. Systems Center

1971 105p 9 refs

Report no. DOT-TSC-NHTSA-71-3; PB-204 806

Systems constraints and required operational characteristics for activating deployable passive restraints were studied. Two methods were chosen for further study: microwave radar and ultrasonic sonar, and the performance characteristics of these methods are described. The radar sensor, comprising standard microwave components and solid state circuitry, was installed on a test vehicle; results were promising but not conclusive. The sonar approach is a translation of the radar sensor into acoustic form. Transducers have been the subject of particular study and

modification. Preliminary results suggest that environmental considerations and adequate target discrimination will be the major problem areas.

Search terms: Passive restraint systems; Radar; Microwave systems; Sonar; Ultrasonic devices; Transducers; Performance characteristics; Solid state devices; Sensors; Target detection; Air bag inflation devices; Reliability; Environmental factors; Noise; Simulation models

AVAILABILITY: NTIS as PB-204 806

HS-820 201 Fld. 5/14; 3/2; 4/5

OCCUPANT MOTION SENSORS: METHODS OF DETECTION AND ANALYSIS. TECHNICAL REPORT

by J. L. Horner; D. W. Ofsevit; G. R. Plank; G. G. Lawrence

Department of Transp., Transp. Systems Center

1971 60p 7 refs

Report no. DOT-TSC-NHTSA-71-4; PB-204 809

Study of methods for measuring occupant motion within a vehicle during crash or impact conditions has been made in order to evaluate restraint systems, using anthropometric dummy, animal, or human occupants. A list of general specifications for occupant motion sensors was drawn up to establish criteria for evaluation of proposed systems. Five systems were built and field tested: potentiometer, linear velocity transducer, ellipsometry, rotational accelerometer, and angular position detector. In addition, computer methods for Fourier analysis of the data produced by these systems have been developed in theory and in programs for a digital computer.

Search terms: Occupant modeling; Occupant kinetics; Occupant kinematics; Restraint system effective-

ness; Motion effects; Test equipment; Measuring instruments; Digital computers; Fourier analysis; Potentiometers; Transducers; Ellipsometers; Accelerometers; Detectors; Sensors; Crash phase; Mathematical analysis; Computerized simulation; Simulation models

AVAILABILITY: NTIS as PB-204 809

HS-820 202 Fld. 5/6

MEASUREMENT OF VEHICLE CONTAMINATION BY EXHAUST GASES. FINAL REPORT

by Steven M. Mathews

Department of Transp., Transp. Systems Center

1971 1v 2 refs

Report no. DOT-TSC-NHTSA-71-7

An investigation of the concentration of carbon monoxide within the passenger compartment of motor vehicles has been made. A sample handling system has been developed to measure the concentrations of carbon monoxide at six inside and outside locations. A test procedure was developed with sixteen possible configurations of window, vent, and trunk lid openings. The sample system and test procedures were used on six different vehicles representing several aerodynamic shapes, different design features, and auxiliary equipment. Data obtained in situations of low traffic density are presented. For all the vehicles tested, the CO concentration was quite low under most conditions. One model was discovered to have high self-contamination when the trunk was open.

Search terms: Carbon monoxide; Carbon monoxide indicators; Exhaust gases; Instrumented vehicles; Automobile models; Automobile design; Aerodynamic configurations; Measuring instruments; Passenger compartments; Driving conditions; Road tests

AVAILABILITY: NTIS

U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

Research Institute, Office of Accident Investigation and Data Analysis

WASHINGTON, D.C. 20590

OFFICIAL BUSINESS

Penalty For Private Use, \$300

POSTAGE AND FEES PAID
NATIONAL HIGHWAY TRAFFIC SAFETY
ADMINISTRATION



NHTSA REGIONAL OFFICES

Region	Address
I	Regional Administrator, NHTSA, Transportation Systems Center, 55 Broadway, Cambridge, Mass., 02142, Tel: 617-494-2681. (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont)
II	Regional Administrator, NHTSA, (Room 400) 200 Mamaroneck Avenue, White Plains, N.Y. 10601 Tel: 914-761-4250 (Ext. 312) (New Jersey, New York, and Puerto Rico)
III	Regional Administrator, NHTSA, Room 817 Federal Building, 31 Hopkins Plaza, Baltimore, Maryland 21201 Tel: 301-962-3878. (Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia)
IV	Regional Administrator, NHTSA, (Suite 400) 1720 Peachtree Road, N.W., Atlanta, Georgia 30309, Tel: 404-526-5537. (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee)
V	Regional Administrator, NHTSA, Suite 214, Executive Plaza, 1010 Dixie Highway, Chicago Heights, Illinois 60411, Tel: 312-756-1950 (Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin)
VI	Regional Administrator, NHTSA, 819 Taylor Street, Room 11A26, Fort Worth, Texas 76102, Tel: 817-334-2021. (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas)
VII	Regional Administrator, NHTSA, P.O. Box 7085, Country Club Station, Kansas City, Missouri 64113, Tel: 816-361-0860 (Ext. 7887) (Iowa, Kansas, Missouri, and Nebraska)
VIII	Regional Administrator, NHTSA, 9393 West Alameda Avenue, Lakewood, Colorado 80226, Tel: 303-324-3253 (Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming)
IX	Regional Administrator, NHTSA, 450 Golden Gate Avenue, Box 36112, San Francisco, California 94102. Tel: 415-556-6415 (Arizona, California, Hawaii, and Nevada)
X	Regional Administrator, NHTSA, 5140 Federal Office Building, Seattle, Washington 98104, Tel: 206-442-5934 (Alaska, Idaho, Oregon, and Washington)